P
Agric
I

STORAGE

Bulletin No. 120 1921

Imperial Bacteriological Laboratory Muktesar
Imperial Delhi
Biblioth
& Medical
Sériels

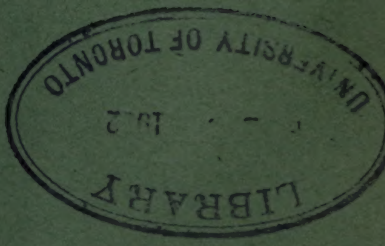
Agricultural Research Institute, Pusa

The Serum Simultaneous Method of Inoculation against Rinderpest

BY

W. A. POOL, M.R.C.V.S.

Offg. Director and First Bacteriologist,
Imperial Bacteriological Laboratory, Muktesar



CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1921

Price As. 2.

Edited by

The Council of the Pusa Agricultural Research Institute which is not, as a body, responsible for the opinions expressed in the Bulletin.

Bulletin No. 120 1921

Agricultural Research Institute, Pusa

The Serum Simultaneous Method of Inoculation against Rinderpest

BY

W. A. POOL, M.R.C.V.S.,

Offg. Director and First Bacteriologist,
Imperial Bacteriological Laboratory, Muktesar.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1921

Agents for the Sale of Books Published by the Superintendent of Government Printing, India, Calcutta.

IN EUROPE.

Constable & Co., 10, Orange Street, Leicester Square, London, W.C.

Kegan Paul, Trench, Trübner & Co., 68-74, Carter Lane, E.C., and 39, New Oxford Street, London, W.C.

Bernard Quaritch, 11, Grafton Street, New Bond Street, London, W.

P. S. King & Sons, 2 & 4, Great Smith Street, Westminster, London, S.W.

H. S. King & Co., 65, Cornhill, E.C., and 9, Pall Mall, London, W.

Grindlay & Co., 54, Parliament Street, London, S.W.

Luzac & Co., 46, Great Russell Street, London, W.C.

W. Thacker & Co., 2, Creed Lane, London, E.C.

T. Fisher Unwin, Ltd., 1, Adelphi Terrace, London, W.C.

Wheldon & Wesley, Ltd., 28, Essex Street, London, W.C.

B. H. Blackwell, 50 & 51, Broad Street, Oxford.

Deighton Bell & Co., Ltd., Cambridge.

Oliver and Boyd, Tweeddale Court, Edinburgh.

E. Ponsonby, Ltd., 116, Grafton Street, Dublin.

Ernest Leroux, 28, Rue Bonaparte, Paris.

Martinus Nijhoff, The Hague, Holland.

IN INDIA AND CEYLON.

Thacker, Spink & Co., Calcutta and Simla.

Newman & Co., Calcutta.

R. Cambray & Co., Calcutta.

S. K. Lahiri & Co., Calcutta.

B. Banerjee & Co., Calcutta.

The Indian School Supply Depôt, 309, Bow Bazar Street, Calcutta, and 226, Nawabpur, Dacca.

Butterworth & Co. (India), Ltd., Calcutta.

Rai M. C. Sarcar Bahadur and Sons, 90-2A, Harrison Road, Calcutta.

The Weldon Library, 57, Park Street, West, Calcutta.

Standard Literature Co., Limited, Calcutta.

Lal Chand & Sons, Calcutta.

Association Press, Calcutta.

Higginbothams & Co., Madras.

V. Kalyanarama Iyer & Co., Madras.

G. A. Natesan & Co., Madras.

S. Murthy & Co., Madras.

Thompson & Co., Madras.

Temple & Co., Madras.

P. R. Rama Iyer & Co., Madras.

Vas & Co., Madras.

E. M. Gopalakrishna Kone, Madura.

Thacker & Co., Ltd., Bombay.

D. B. Taraporevala, Sons & Co., Bombay.

Mrs. Radhabai Atmaram Sagoon, Bombay.

Sunder Pandurang, Bombay.

Gopal Narayan & Co., Bombay.

Ramchandra Govind & Son, Kalbadevi, Bombay.

Proprietor, New Kitabkhana, Poona.

The Standard Bookstall, Karachi.

Mangaldas Harkisandas, Surat.

Karsandas Narandas & Sons, Surat.

A. H. Wheeler & Co., Allahabad, Calcutta and Bombay.

N. B. Mathur, Supt., Nazir Kanun-i-Hind Press, Allahabad.

Munshi Seeta Ram, Managing Proprietor, Indian Army Book Depôt, Juhi, Cawnpore.

Rai Sahib M. Gulab Singh & Sons, Mufid-i-Am Press, Lahore and Allahabad.

Rama Krishna & Sons, Lahore.

Supt., American Baptist Mission Press, Rangoon.

Manager, the "Hitavada," Nagpur.

S. C. Talukdar, Proprietor, Students and Company, Cooch Behar.

A. M. & F. Ferguson, Ceylon.

Manager, Educational Book Depôts, Nagpur and Jubbulpore.*

Manager of the Imperial Book Depôt, 63 Chandney Chauk Street, Delhi.*

Manager, "The Agra Medical Hall and Co-operative Association, Ltd." (Successors to A. John & Co., Agra).*

Supt., Basel Mission Book and Tract Depository, Mangalore.*

P. Varadachary & Co., Madras.*

H. Liddell, Printer, etc., 7, South Road, Allahabad.*

Ram Dayal Agarwala, 184, Katra, Allahabad.*

D. C. Anand & Sons, Peshawar.*

Manager, Newal Kishore Press, Lucknow.*

Maung Lu Gale, Proprietor, Law Book Depôt, Mandalay.*

* Agents for the sale of Legislative Department publications only.

The Serum Simultaneous Method of Inoculation against Rinderpest.

[*Received for publication on 14th December 1920.*]

THESE instructions are designed to meet the needs of a large dairy in India consisting largely of imported stock. They will serve as a type and can be modified to suit other herds by the inoculating officer.

They are based on the work carried out in the Muktesar laboratory during recent years. Until further experience is gained it would be unsafe to modify them. Further work on this subject is in progress.

1. Technique of the inoculation.

(*a*) *Immunising the animals.*

Serum is injected subcutaneously over one shoulder, and virulent rinderpest blood taken from a virus producer at the height of the disease is injected at the same time subcutaneously over the other shoulder.

On the 7th or 8th day, a second dose of 5 c. c. of virulent blood (without any more serum) is inoculated into any animals which do not show a rinderpest reaction from the first inoculation.

This second dose is given in the inoculations carried out under the direction of this Laboratory but is not always given in other countries where this method of inoculation is employed for the eradication of rinderpest.

(*b*) *Method of providing the virulent blood.*

This must be obtained from the branch laboratory at Bareilly, sealed in pipettes or in bulk and packed in a vacuum flask in a freezing mixture or in an ice chest in ice.

(*i*) *By inoculating virus producers.* This method is necessary when the virulent blood cannot be used before it is 48 hours old. If it is more than 48 hours old there is a danger that it may have lost its virulence.

The inoculation of avirulent blood would establish a sense of false security. The inoculation of virus producers on the spot ensures efficient inoculation.

Susceptible male calves, 6—9 months old or at the outside 1½ years old, should be provided to act as virus producers, and they should be inoculated with 5 c. c. of virulent blood so that they may contract rinder-

pest. These calves must be of as susceptible a breed to rinderpest as possible. Imported European stock and Himalayan hill cattle are the most susceptible. Half-bred European stock are very susceptible and ¼-bred stock are fairly susceptible.

Of the other indigenous breeds shown in the table of doses of serum in section 2, experience obtained in the inoculation of the cattle of Government military dairies shows that Scindi cattle are the most susceptible and Hariana cattle the least, the Sahniwal cattle occupying an intermediate position.

Appendix A gives a suggested model time table for use when virus producers have to be inoculated.

(*ii*) *By inoculating virulent blood obtained in bulk.* If the virulent blood can be obtained in bulk, kept cool *en route* and used within 48 hours of being drawn from the infected animal, a great saving in time and labour is effected.

Appendix B gives a suggested model time table for use when the blood can be obtained in bulk.

2. Dose of serum.

Class of animal	Dose of serum in cubic centimeters per 600 lb. body weight.
Ayreshire cattle	250—300
Holstem cattle	250—300
⅞ pure bred cattle	220—240
¾ pure bred cattle	175—200
½ pure bred cattle	125—150
¼ pure bred cattle	100—125
⅛ pure bred cattle	80—100
Country breeds.	
Scindi breed	60
Sahniwal breed	40
Hariana breed	30
Buffaloes.	
Delhi	60

The doses for other country bred animals are not known, and an estimate of their susceptibility must be obtained locally from Veterinary Advisers or Superintendents, Civil Veterinary Department.

3. Dose of virulent blood per animal of any weight.

Pure breds and cross breds	½ c.c.
Country breds	1 c.c.

4. Animals which should not be inoculated.

Calves under 9 months old, cows more than 3 months in calf, cows in milk and any weak or sick animal should not be inoculated by this method. Imported stock should never be inoculated until acclimatized.

5. Care of the animals being immunised.

The inoculation of an animal with rinderpest may be a severe strain on its health if any complication occurs even though serum protection is given.

While being immunised, the animals should be protected from any severe climatic conditions and the general animal mastership should be faultless.

A convenient proportion (say 10 per cent.) representative of each class of the inoculated animals should be selected haphazard. These animals should be kept under accurate observation to give a general idea of the reactions obtained. A full temperature chart should be maintained for each animal of this batch.

The temperatures of the remainder of the animals should be taken, and they should be carefully watched for three weeks from the date of the first inoculation. Any showing severe symptoms should be added to those under accurate observation. Severe symptoms should be treated as they occur, though usually interference is unnecessary except when piroplasmosis arises as a complication.

6. Measures to prevent the inoculation of piroplasmosis, with the virulent blood.

A temperature chart for each virus producer must be maintained, and blood smears from each animal must be carefully examined daily from the time when the temperature reaction begins until the blood is used.

Blood from an animal known to be affected with piroplasmosis must not be used. This method of diagnosis, which admits of blood examinations for 2 or 3 days only, will not of course prove definitely that an animal is not infected with piroplasmosis but it is as much as is practicable in field conditions.

7. Piroplasmosis in the animals inoculated by the serum simultaneous method.

Experience has shown that some animals suffer from piroplasmosis as a complication of the rinderpest reaction. When due precautions are taken, this is usually due to a relapse from a previous infection on the part of the animal inoculated.

Blood smears should be examined from any showing a high temperature.

Any animal showing piroplasmosis should be given an intravenous injection of 20 c.c. of a saturated (about 3 per cent.) solution of Trypan blue in 0·8 per cent. saline per 100 lb. body weight. The maximum dose for big animals should not exceed 250 c.c. The solution should be freshly prepared, filtered and be injected at blood heat.

8. Danger of infecting healthy animals with rinderpest that are not being immunised.

If adequate control is not exercised, the virus is always a source of danger to healthy animals. Therefore the locality chosen must be such that there is no danger of infecting animals in the vicinity that are not going to be inoculated such as the cows in calf beyond three months or in milk or village cattle.

The animals to be inoculated must not be placed in danger of infection until the actual day of inoculation.

The animals inoculated by the serum simultaneous method are infective and must not be allowed to mix with healthy ones for 3 weeks after the last animal of the batch has ceased to show symptoms of the reaction or a minimum of 5 weeks after the last batch was immunised.

The virulent blood obtained in the first instance, whether sent in pipettes in a vacuum flask or in bottles in an ice chest, must be very carefully guarded that there may be no chance of spreading infection when *en route* to the scene of inoculation.

When possible, a capable messenger should always be sent with suitable receptacles to bring the virulent blood. When this is impossible and it is necessary to send it by post, a hermetically sealed container must always be used.

9. Duration of the immunity conferred.

Experience of this method of inoculation has shown that the immunity conferred is durable.

10. Safety of this method of inoculation in India.

In the course of over 5,000 inoculations of animals carried out under the direction of this laboratory in all parts of India, including all classes of animals as shown in the table of doses in section 2, the total mortality has been under 0·8 per cent. Many of the deaths which produced this mortality figure were from causes other than rinderpest, and in ordinary circumstances should not have occurred as a result of the inoculation.

Conditions from one cause or another have not always been ideal so the test of the method may be regarded as a severe one.

The inoculations have all been carried out on the plains during the cold weather. This laboratory has no experience of any inoculations carried out during the hot weather.

11. Literature.

The following literature bears on this subject and should be consulted:—

(*i*) The Annual Reports of the Muktesar Laboratory for the years 1916-17, 1917-18, 1918-19 and 1919-20.

(*ii*) "The Vitality of the Rinderpest Virus outside the Animal Body under Natural Conditions" by the late A. W. Shilston, M.R.C.V.S., Second Bacteriologist, Imperial Bacteriological Laboratory, Muktesar. Memoirs of the Department of Agriculture in India, Veterinary Series, Vol. III, No. 1.

Appendix A.

Suggested model time table for inoculating a herd when virus producers have to be inoculated.

Days	
1	Inoculate two virus producers (virus producers 1 and 2) with virulent blood.
2	
3	
4	
5	
6	Virus producers react. Bleed. Defibrinate and if necessary store in cold container. Inoculate first batch of animals by the serum simultaneous method (Batch A).
7	Inoculate second batch of animals by the serum simultaneous method (Batch B). (If necessary draw fresh virulent blood.)
8	Inoculate third batch of animals by the serum simultaneous method (BatchC). (If necessary draw fresh virulent blood.) Inoculate virus producers 3 and 4 from virus producers 1 and 2.
9	
10	
11	
12	
13	Virus producers 3 and 4 react. Inoculate Batch A, when necessary, with 5 c.c. of virulent blood from virus producer 3 or 4.
14	Inoculate Batch B, when necessary, with virulent blood from virus producers 3 and 4.
15	Inoculate Batch C, when necessary, with virulent blood from virus producer 3 or 4.
16	Observe and treat as necessary.
17	
18	
19	
20	
21	
22	
23	
etc.	

NOTE. If the virus producers are of a breed which is not very susceptible a larger number should be inoculated as in this case a reaction is not always obtained.

Appendix B.

Suggested model time table for inoculating a herd when the virulent rinderpest blood can be obtained in bulk.

Days	
1	Virulent blood arrives. Inoculate the first batch of animals by the serum simultaneous method (Batch A).
2	Virulent blood arrives. Inoculate the second batch of animals by the serum simultaneous method (Batch B).
3	Virulent blood arrives. Inoculate the third batch of animals by the serum simultaneous method (Batch C).
4	
5	
6	
7	
8	Virulent blood arrives. Inoculate the animals of Batch A, when necessary, with 5 c.c.
9	Virulent blood arrives. Inoculate the animals of Batch B, when necessary, with 5 c.c.
10	Virulent blood arrives. Inoculate the animals of Batch C, when necessary, with 5 c.c.
11	Observe and treat as necessary.
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	

In this time table it is assumed that the virulent blood is 48 hours old by the time it is inoculated.

If it could be obtained more expeditiously, the programme could be modified accordingly as regards arrangements for fresh supplies.

From the above it will be seen that usually it would only be convenient to obtain the virulent blood in bulk when all the animals could be inoculated in one day or the blood could be obtained quickly.

If this cannot be done it would be more convenient and economical to inoculate virus producers on the spot, as otherwise messengers and containers in sufficient number would have to be provided for the conveyance of the blood.

Publications of the Imperial Department of Agriculture in India

To be had from :—

The Office of the Agricultural Adviser to the Government of India, Pusa, Bihar, and from the following Agents :—

(1) Thacker, Spink & Co., Calcutta.
(2) W. Newman & Co.,Calcutta.
(3) Rai M. C. Sarkar Bahadur & Sons, Calcutta.
(4) Higginbothams & Co., Madras.
(5) Thompson & Co., Madras.
(6) D. B. Taraporevala, Sons & Co., Bombay.
(7) Thacker & Co., Ltd., Bombay.
(8) Sunder Pandurang, Bombay.
(9) Rai Sahib M. Gulab Singh & Sons, Mufid-i-am Press, Lahore.
(10) Manager, Educational Book Depôt, Nagpur.

A complete list of the publications of the Imperial Department of Agriculture in India can be obtained on application from the Agricultural Adviser to the Government of India, Pusa, Bihar, or from any of the above-mentioned agents.

These publications are :—

1 The *Agricultural Journal of India*. A Journal dealing with subjects connected with agricultural economics, field and garden crops, economic plants and fruits, soils, manures, methods of cultivation, irrigation, climatic conditions, insect pests, fungus diseases, co-operative credit, agricultural cattle, farm implements, and other agricultural matters in India. Illustrations, including coloured plates, form a prominent feature of the Journal. It is edited by the Agricultural Adviser to the Government of India, and is issued once every two months or six times a year. *Annual Subscription*, Rs. 6 or 9*s*. 6*d*., including postage. Single copy, R. 1-8 or 2*s*.

2. Scientific Reports of the Agricultural Research Institute, Pusa.
3. Annual Review of Agricultural Operations in India.
4. Proceedings of the Board of Agriculture in India.
5. Proceedings of Sectional Meetings of the Board of Agriculture.
6. Memoirs of the Imperial Department of Agriculture in India :

   (*a*) Botanical Series.
   (*b*) Chemical Series.
   (*c*) Entomological Series.
   (*d*) Bacteriological Series.
   (*e*) Veterinary Series.

7. Bulletins issued by the Agricultural Research Institute, Pusa.
8. Indigo Publications.
9. Books.

The following are the publications of the last two years :—

Scientific Reports of the Agricultural Research Institute and College, Pusa (including the Report of the Imperial Cotton Specialist), for the year 1918-19. Price, R. 1-4 or 2*s*.

Scientific Reports of the Agricultural Research Institute, Pusa (including the Report of the Secretary, Sugar Bureau), for the year 1919-20. Price, R. 1.

Report on the Progress of Agriculture in India, for the year 1918-19. Price, R. 1-8 or 2*s*. 3*d*.

Review of Agricultural Operations in India, 1919-20. Price, R. 1-4.

Proceedings of the Board of Agriculture in India, held at Pusa on the 1st December, 1919, and following days (with Appendices). Price, As. 12 or 1*s*. 3*d*.

Proceedings of the Second Meeting of Mycological Workers in India, held at Pusa on the 20th February 1919, and following days. Price, As. 11 or 1*s*.

Proceedings of the First Meeting of Agricultural Chemists and Bacteriologists, held at Pusa on 24th February, 1919, and following days. Price, R. 1 or 1*s*. 6*d*.

Proceedings of the First Meeting of Veterinary Officers in India, held at Lahore on the 24th March, 1919, and following days (with Appendices). Price, As. 8 or 9*d*.

Proceedings of the Third Entomological Meeting, held at Pusa in February 1919. Price, Rs. 17-8.

MEMOIRS OF THE DEPARTMENT OF AGRICULTURE IN INDIA

Botanical Series

Vol. X, No. II. Studies in Indian Sugarcanes, No. 4. Tillering or Underground Branching, by C. A. BARBER, C.I.E., SC.D., F.L.S. Price, Rs. 4-4 or 7*s*.

Vol. X, No. III. Studies in Indian Sugarcanes, No. 5. On testing the suitability of sugarcane varieties for different localities, by a system of measurements. Periodicity in the growth of the sugarcane, by C. A. BARBER, C.I.E., SC.D., F.L.S. Price, R. 1-12 or 3*s*.

Vol. X, No. IV. A *Pythium* Disease of Ginger, Tobacco and Papaya, by L. S. SUBRAMANIAM. Price, R. 1-8 or 2*s*. 6*d*.

Vol. X, No. V. Studies in the Pollination of Indian Crops, 1, by A. HOWARD, C.I.E., M.A., GABRIELLE L. C. HOWARD, M.A., and ABDUR RAHMAN KHAN. Price, R. 1-4 or 2*s*. 6*d*.

Vol. X, No. VI. "Kumpta" Cotton and its Improvement, by G. L. KOTTUR, B. /g., Price, R. 1-12 or 3*s*.

Vol. XI, No. I. Some Aspects of the Indigo Industry in Bihar. Part I. The Wilt Disease of Indigo. Part II. The factors underlying the seed production and growth of Java Indigo, by ALBERT HOWARD, C.I.E., M.A., and GABRIELLE L. C. HOWARD, M.A., with the assistance of CHOWDHARY RAMDHAN SINGH and MAULVI ABDUR RAHMAN KHAN. Price, R. 1-2 or 2*s*.

Vol. XI, No. II. Studies in Diseases of the Jute Plant. (1) *Diplodia Corchori*, Syd., by F. J. F. SHAW, B.SC., A.R.C.S., F.L.S. Price, Rs. 2 or 2*s*. 8*d*.

Vol. XI, No. III. Morphology and Parasitism of *Acrothecium Penniseti* n. sp. (A New Disease of *Pennisetum typhoideum*), by MANORANJAN MITRA, M.SC. Price, R. 1-4 or 2*s*.

Chemical Series

Vol. V, No. V. The Phosphate Requirements of some Lower Burma Paddy Soils, by F. J. WARTH, M.SC., B.SC., and MAUNG PO SHIN. Price, R. 1-12 or 3*s*. 3*d*.

Vol. V, No. VI. Absorption of Lime by Soils, by F. J. WARTH, M.SC., B.SC., and MAUNG PO SAW. Price, R. 1-2 or 2*s*.

Vol. V, Nos. VII & VIII. The Gases of Swamp Rice Soils. V—A Methane-oxidizing Bacterium from Rice Soils, by P. A. SUBRAHMANYA AYYAR, B.A.,; and The Gases of Swamp Rice Soils. VI—Carbon Dioxide and Hydrogen in relation to Rice Soils, by W. H. HARRISON, D.SC. Price, As. 12 or 1*s*. 3*d*.

Vol. V, No. IX. The Retention of Soluble Phosphates in Calcareous and Non-calcareous Soils, by W. H. HARRISON, D.SC., and SURENDRA LAL DAS, M.SC. (*In the press.*)

Vol. V, No. X. Windrowing Sugarcane in the North-West Frontier Province. Part I. The Effect on the Economical and Agricultural Situation, by W. ROBERTSON BROWN. Part II. The Effect on the Composition of Sugarcane, by W. H. HARRISON, D.SC., and P. B. SANYAL, M.SC. Price As. 12 or 1*s*.

Entomological Series

Vol. V, No. V. The Rice Leaf-hoppers (*Nephotettix bipunctatus*, Fabr. and *Nephotettix apicalis*, Motsch.), by C. S. MISRA, B.A. Price, R. 1-8 or 3*s*.

Vol. V, No. VI. *Lantana* Insects in India. Being the Report of an Inquiry into the Efficiency of Indigenous Insect Pests as a Check on the Spread of *Lantana* in India by RAO SAHIB Y. RAMACHANDRA RAO, M.A., F.E.S. Price, Rs. 2-4 or 4*s*. 6*d*.

Vol. VI, Nos. I—IX. Life-histories of Indian Insects : Microlepidoptera, by T. BAINBRIGGE FLETCHER R.N., F.L.S., F.C.S., F.Z.S. Price, Rs. 7-8 or 11*s*. 3*d*.

Vol. VII, Nos. I & II. New Indian Gall Midges (Diptera), by E. P. FELT and Description of a Rhinocyphine larva from Shillong, by MAJOR F. C. FRASER, I.M.S. Price, As. 12, or 1*s*.

Vol. VII, No. III. Indian Grass Gall Midges, by E. P. Felt. Price, As. 10 or 1*s*.

Bacteriological Series

Vol. I, No. VIII. Pebrine in India, by C. M. HUTCHINSON, C.I.E., B.A. Price, Rs. 3 or 5*s.* 6*d.*
Vol. I, No. IX. Studies on the Root Nodule Organism of the Leguminous Plants, by N. V. JOSHI, M.SC., B.A., L.AG. Price, R. 1-4 or 2*s.* 6*d.*

Veterinary Series.

Vol. III, No. II. The Virulence of Tubercle Bacilli isolated from Bovine Lesions in India, by A. L. SHEATHER, B.SC., M.R.C.V.S. (*In the press.*)
Vol. III, No. III. Bovine Lymphangitis, by A. L. SHEATHER, B.SC., M.R.C.V.S. (*In the press.*)

BULLETINS ISSUED BY THE AGRICULTURAL RESEARCH INSTITUTE, PUSA

No. 88. Cawnpore-American Cotton: An Account of Experiments in its Improvement by Pure Line Selection and of Field Trials, 1913-1917, by B. C. BURT, B.SC., and NIZAMUDDIN HAIDAR. Price, As. 10 or 1*s.*
No. 89. Second Hundred Notes on Indian Insects. Price, R. 1-4 or 2*s.*
No. 90. A Malarial Parasite in the Blood of a Buffalo, by A. L. SHEATHER, B.SC., M.R.C.V.S. Price As. 6 or 7*d.*
No. 91. Notes on Practical Salt Land Reclamation, by G. S. HENDERSON, N.D.A., N.D.D. Price As. 6.
No. 92. Syngamus laryngeus in Cattle and Buffaloes in India, by A. LESLIE SHEATHER, B.SC., M.R.C.V.S., and A. W. SHILSTON, M.R.C.V.S. Price, As. 6.
No. 93. The Orange: A Trial of Stocks at Peshawar, by W. ROBERTSON BROWN. Price, As. 6.
No. 94. A Preliminary Note on the Behaviour in North India of the first batch of Sugarcane Seedlings distributed from the Sugarcane-breeding Station, Coimbatore, by T. S. VENKATRAMAN, B.A. Price, As. 8.
No. 95. A Note on the Treatment of Surra in Camels by Intravenous Injections of Tartar Emetic by H. E. CROSS, M.R.C.V.S., D.V.H., A.SC. Price, As. 2.
No. 96. A Summary of Experiments on Rice in Bihar and Orissa from 1912 to 1919, by G. C. SHERBARD, B.A. Price, As. 10.
No. 97. *Ustilago Crameri*, Koern. on *Setaria italica*, by S. SUNDERARAMAN, M.A. Price, As. 4.
No. 98. The Course that Surra runs in Camels when Naturally Contracted and when Artificially Inoculated, by H. E. CROSS, M.R.C.V.S., D.V.H., A.SC. Price, As. 5.
No. 99. The Course that Camel Surra runs in Ponies, Buffaloes and other Animals, by H. E. CROSS, M.R.C.V.S., D.V.H., A.SC. Price, As. 4.
No. 100. Annotated List of Indian Crop-Pests, by T. BAINBRIGGE FLECHER, R.N., F.L.S., F.E.S., F.Z.S. Price, R. 1-8.
No. 101. Some Insects recently noted as Injurious in South India, by T. V. RAMAKRISHNA AYYAR, B.A., F.E.S., F.Z.S. Price, As. 8.
No. 102. Borers in Sugarcane, Rice, etc., by T. BAINBRIGGE FLETCHER, R.N., F.L.S., F.E.S., F.Z.S., and C. C. GHOSH, B.A. Price, R. 1.
No. 103. Some Indian Economic Aleyrodidæ, by C. S. MISRA, B.A. Price, As. 8.
No. 104. The Rice Leaf-hoppers, by C. S. MISRA, B.A. Price, As. 6.
No. 105. Cotton Bollworms in India, by T. BAINBRIGGE FLETCHER, R.N., F.L.S., F.E.S., F.Z.S., and C. S. MISRA, B.A. Price, As. 8.
No. 106. The Pink Bollworm in Egypt, by LEWIS H. GOUGH, PH.D., F.E.S. Price, R. 1.
No. 107. Experiments in Egypt on the Survival of the Pink Bollworms (resting state larvæ) in Ripe Damaged Cotton Bolls buried at different depths, by F. C. WILLCOCKS Price, As. 5.
No. 108. Some Pests of Cotton in North Bihar, by C. S. MISRA, B.A. Price, As. 6.
No. 109. *Tukra* Disease of Mulberry, by C. S. MISRA, B.A. Price, As. 4.
No. 110. The Preservation of Wood against Termites, by T. BAINBRIGGE FLETCHER, R.N., F.L.S., F.E.S., F.Z.S., and C. C. GHOSH, B.A. Price, As. 3.
No. 111. Stored Grain Pests, by T. BAINBRIGGE FLETCHER, R.N., F.L.S., F.E.S., F.Z.S., and C. C. GHOSH, B.A. Price, As. 14.
No. 112. Notes on Rearing Insects in Hot Climates, by T. BAINBRIGGE FLETCHER, R.N., F.L.S., F.E.S., F.Z.S., and C. C. GHOSH, B.A. Price, As. 7.

BULLETINS ISSUED BY THE AGRICULTURAL RESEARCH INSTITUTE, PUSA—(*concld.*)

No. 113. Hints on Collecting and Preserving Insects, by T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S. Price, As. 10.

No. 114. The Preparation and Reproduction of Scientific Illustrations, by A. W. Slater. Price, As. 4.

No. 115. Note on Plant Imports into India, by T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S. Price, As. 7.

No. 116. A Survey of the Indian Poppy-growing Districts for Morphine Content of the Opium produced, by H. E. Annett, D.Sc. (Lond.), F.I.C., M.S.E.A.C., Hari Das Sen, M.Sc., and Har Dayal Singh, B.Sc. Price, As. 2.

No. 117. Experiments with Castor Seed Conducted at Sabour, by C. Somers Taylor, B.A. (*In the press.*)

No. 118. The Saving of Irrigation Water in Wheat Growing, by Albert Howard, C.I.E., M.A. and Gabrielle L. C. Howard, M.A. Price, As. 4.

No. 119. The Agricultural Development of Baluchistan, by Albert Howard, C.I.E., M.A., and Gabrielle L. C. Howard, M.A. Price, As. 6.

No. 120. The Serum Simultaneous Method of Inoculation against Rinderpest, by W. A. Pool, M.R.C.V.S. Price, As. 2.

No. 121. Notes on Contagious Abortion in Pony and Donkey Mares, by R. Branford, M.R.C.V.S., and T. M. Doyle, F.R.C.V.S. (*In the press.*)

No. 122. Pusa 12 and Pusa 4 in the Central Circle of the United Provinces, by B. C. Burt, M.B.E., B.Sc., F.C.S., Albert Howard, C.I.E., M.A., and Gabrielle L. C. Howard, M.A. Price, As. 11.

INDIGO PUBLICATIONS

No. 6. The Effect of Manuring with Superphosphate and Sannai on the Yield of Crops on Indigo Planters' Estates in Bihar—especially of Rabi Crops in the Season 1918-1919, by W. A. Davis, B.Sc., A.C.G.I. Price, As. 6.

No. 7. The Conditions affecting the Quality of the Java Indigo Plant (Leaf yield and richness of the leaf in indigotin), by W. A. Davis, B.Sc., A.C.G.I. Price, As. 9.

No. 8. Note on the Development of the Indigo Industry in Assam in Conjunction with Tea and other Crops, by W. A. Davis, B.Sc., A.C.G.I. Price, As. 3.

No. 9. The Nature of the Changes Occurring during the Extraction of Indigo from the Java Plant (*Indigofera arrecta*), by W. A. Davis, B.Sc., A.C.G.I Price, R. 1.

No. 10. Note on the Deterioration of Indigo Seed during Storing, by Major W. R. G. Atkins, Sc.D., F.I.C. Price, As. 3.

BOOKS

"Wheat in India," by Albert Howard, M.A., A.R.C.S., F.L.S.; and Gabrielle L. C. Howard, M.A. 288 pp. Price, Rs. 5 or 7*s.* 6*d.*

"A Description of the Imperial Bacteriological Laboratory, Muktesar: Its Work and Products," by Major J. D. E. Holmes, M.A., D.Sc., M.R.C.V.S. Price, As. 8 or 9*d.*

"Agriculture in India," by James Mackenna, M.A., I.C.S. Price, As. 4 or 5*d.*

"Some Diseases of Cattle in India. A Handbook for Stock-owners." Price, As. 8 or 9*d.*

"The Importance of Bacterial Action in Indigo manufacture," by C. M. Hutchinson, B.A. Price, As. 2 or 3*d.*

SGPI—S3—183AAtoGofI—9-8-21—1,500